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GIFFORD PINCHOT, Forester.

SILVICAL LEAFLET 15.

WHITE SPRUCE.

Picea canadensis (Mill.) B. S. P.

White spruce is a tree of the far North. In the United States it occurs in only limited quantities except in Alaska, where it is fairly abundant. It is not a particularly important timber tree, but is valuable for pulp. As the more accessible forests of red spruce become depleted, the white spruce of Canada and Alaska will be drawn upon heavily to supply the paper mills.

RANGE AND OCCURRENCE.

White spruce is transcontinental in range. It extends from the coasts of Maine, Labrador, and Newfoundland westward to the interior of Alaska, and to the Pacific coast at Cook Inlet. From near the shores of the Arctic Ocean and Hudson Bay it reaches as far south as northern New England, New York, Michigan, Wisconsin, and Minnesota. It grows in the Black Hills of South Dakota, and in the Rocky Mountains in Wyoming and Montana. Some authorities have asserted, however, that the spruce found in the Black Hills, Montana, and Wyoming is not *Picea canadensis*, but a new species which they have named *Picea columbiana*.

White spruce grows along river banks and terraces in low, moist situations with fairly good drainage, such as the margins of swamps and lakes, and up the sides of ridges and hills, occasionally to elevations of from 2,000 to 4,000 feet in the north. At its southern limits in the eastern United States it frequently occupies springy hillsides, the banks of streams, and the edges of swamps, the centers of which it yields to black spruce, tamarack, and arborvitæ. Throughout Labrador and central British Columbia the white spruce forests are composed of compact groves of merchantable timber in well-watered valleys. On rocky hillsides in this region the tree is less abundant and smaller. On the borders of the treeless plains of Manitoba it occupies sand hills and dry slopes of river banks, but gives way to jack pine on the drier soils. It is the principal timber tree in the territory drained by the

Yukon, where on alluvial flats and on islands it forms dense groves and belts which become more open away from the river.

In the Klondike region it sometimes reaches timber line at an altitude of 3,500 or 4,000 feet on gentle slopes and in sheltered tributary gulches with abundant sunlight. Toward its northern limit in Alaska it becomes more and more dwarfed, seeks protected situations in gulches, and commonly grows in small clumps. It is the dominant tree in the Kenai Peninsula of Alaska, where it occupies the drier situations. It is replaced in the swamps here by black spruce. In Alaska and northern British Columbia white spruce is very scrubby in low, swampy areas, but makes better growth on higher ground, and attains its best development on high bars along the streams and in sheltered ravines.

In the Rocky Mountains of Alberta and Montana white spruce grows near the water courses and in moist soils as high as 5,000 feet above the sea. In the Black Hills of South Dakota the spruce forests are found along stream beds where the soil is very moist, and on northerly slopes.

CLIMATE.

Near the northern limit of its range white spruce endures a climate of great severity, with a short growing season during which frosts are not rare. In the winter the snowfall is heavy, extremely cold spells are frequent, and the trees are subjected to severe drying winds. Sunlight is never intense in these northern latitudes even during the short summers.

The milder climate of the northern United States and southern Canada, where many less hardy species thrive, appears to be unfavorable for the best growth of white spruce, which occurs here only as scattered individuals, and does not reach the size which it attains farther north.

ASSOCIATED SPECIES.

White spruce grows sparingly in the eastern United States, and is usually scattered among other species in mixed forests. In New England it is found in forests of red spruce, hemlock, balsam, white pine, sugar maple, white and yellow birches, beech, and aspen. In northern Michigan, Wisconsin, and Minnesota it associates on the borders of swamps with black spruce, balsam, tamarack, and arborvitæ, and in better drained situations with white pine, hemlock, and hardwoods, notably aspen and paper birch.

In Canada its chief associates are black spruce in moist localities and aspen and birch in better drained situations. In northern British Columbia white spruce forms extensive pure forests along the rivers and on the lower slopes of valleys. It often gives way to black spruce, tamarack, or cottonwoods on the flats, and to jack pine or lodgepole

pine on dry terraces. Where it ascends to timber line in the inland mountains of northern Canada it is sometimes associated with alpine fir.

In Alaska white spruce is the dominant tree in the Panhandle country, and frequently forms dense, pure groves and strips of forest. It is here closely associated with paper birch and aspen, and with cottonwoods near the streams. In the Alaska Mountain range it grows with birch and cottonwood and also with willows and red alder. Near Cook Inlet white spruce is associated with black hemlock and Sitka spruce on slopes and slightly elevated flats. In the inland or plateau type of forest on the Kenai Peninsula it grows with black hemlock, balm of Gilead, aspen, and paper and western birches. Toward its northern limit in Alaska it becomes more and more subordinate to the poplars, and occurs only individually or in small clumps scattered among birch and poplar.

In the Rocky Mountains of Alberta and northern Montana white spruce mingles to some extent with Engelmann spruce in stream beds near its upper altitudinal limits. It sometimes forms pure forests in the Black Hills of South Dakota, but in most places there is a varying per cent of western yellow pine and aspen in mixture.

HABIT.

White spruce is a tree of medium size. It attains at maturity, under favorable conditions, an average height of 100 feet and a diameter of 30 inches. In dense stands the bole is straight and the crown small and conical. The dead limbs are persistent, however, and on this account the lumber is knotty.

The wood is yellowish, brittle, soft, light, and not very strong. The bark is gray-brown and breaks up into scaly plates. The foliage is light green and has a disagreeable odor.

SOIL AND MOISTURE.

White spruce is found most frequently on sandy loam soils, and is satisfied with a moderate supply of moisture. Very sandy soils, upon which white pine thrives, are not favorable to it, but it will grow on extremely shallow soil and in all situations from the margins of swamps to the tops of mountains. The tree grows largest in moist but well-drained localities, in finely divided, porous soil; wherever the soil is either too dry or too wet it is dwarfed and of slow growth.

TOLERANCE.

White spruce possesses considerable shade-enduring capacity, by virtue of which it will live and maintain a slow growth for many years under a heavy crown cover. Its ability to recover from suppression is marked, and is only exceeded by that of black and red spruces. In its light requirements it resembles balsam fir. The branches, however, are

very persistent, and long, clear stems are produced only when the trees grow in close stands. Its ability to thrive under light shade enables it to succeed such intolerant species as poplars and birches, where, after fire or lumbering, these have usurped good spruce ground.

REPRODUCTION.

White spruce is not an exceedingly prolific seed bearer, although some seed is usually produced every year. Years of especially heavy seed production occur at more or less regular intervals, but are not simultaneous in all parts of its range. In New England the period between heavy seed years is said to be about eight years.

The seeds, which mature the first season, are winged and adapted for distribution by the wind. They will germinate either on organic or mineral soil wherever there is suitable moisture. Reproduction is usually good under mature spruce stands, where the ground is more or less covered with moss and there is considerable organic soil. It reproduces poorly on hardwood land in the East on account of the usual thick matting of leaf litter. Decayed logs covered with moss present favorable conditions for germination, and on the moist mineral soil near streams there is often excellent reproduction. Their tolerance allows the seedlings of white spruce to thrive under a crown cover dense enough to exclude most of the tree's associates.

MANAGEMENT.

Three characteristics of white spruce point to a selection system of management—its successful reproduction and seedling growth under shade, its tolerance and ability to recover from long suppression, and the presence of trees of all ages in typical spruce forests. An added consideration is the advisability of preserving the soil from drying too much. The above considerations apply with even more force when white spruce is grown in mixed forests, since the selection system, which is so well adapted to its requirements, would give it an advantage over less tolerant competitors.